P ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 04 October 2000 (04.10.00)	
International application No. PCT/SE00/00097	**Applicant's or agent's file reference** 2006274
International filing date (day/month/year) 18 January 2000 (18.01.00)	**Priority date** (day/month/year) 18 January 1999 (18.01.99)
Applicant EKBERG, Peter	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

14 July 2000 (14.07.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Claudio Borton
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PC-2006274	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/SE00/00097	International filing date *(day/month/year)* 18.01.2000	Priority date *(day/month/year)* 18.01.1999
International Patent Classification (IPC) or national classification and IPC7 H 01 J 9/20 // G 03 F 7/20		
Applicant Micronic Laser Systems AB et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
14.07.2000	03.05.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88 Telex 17978 PATOREG-S	Authorized officer Tomas Erlandsson/MN Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/00097

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed

☒ the description:
pages 1-9 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☒ the claims:
pages _____ , as originally filed
pages _____ , as amended (together with any statement) under article 19
pages _____ , filed with the demand
pages 10-13 , filed with the letter of 13.03.2001

☒ the drawings:
pages 1-2 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☐ the sequence listing part of the description:
pages _____ , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/00097

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-22	YES
	Claims		NO
Inventive step (IS)	Claims	1-22	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-22	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to a method and a system for producing large area display panels.

The object of the invention is t improve the precision of such systems. This is achieved by a process comprising the following steps:

- A first mask is manufactured on the basis of input data.
- A wafer is exposed, which results in a pattern based on the first mask.
- That pattern is compared with a desired pattern. In particular, position errors are measured.
- A second corrected mask is manufactured.
- The second mask is used in the manufacturing.

Documents cited in the International Search Report:

D1 US 5815685 A
D2 WO 9705526 A1

D1 relates to a system and method for correcting pattern data of an integrated circuit or the like. In one embodiment (column 13, lines 5-34) a reference pattern is used for exposing a resist layer on a substrate. A pattern is formed in the resist and then the substrate is etched. The pattern obtained after exposure and etching is measured and compared with the reference pattern. Finally some kind of correction processing is made. The method mainly concerns correction of light proximity effects.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

In D2 a lithography system with a programmable reticle, is disclosed. The system is intended for manufacturing integrated circuits. It is shown that it is well known to expose a wafer by using a first mask, to compare the obtained result with a desired one and to make a new mask based on that comparison (side 2, lines 3-16, side 7, lines 19-28, figure 1). The object of this system is to correct logical errors in the input data by re-programming the programmable reticle.

As mentioned in the present patent application, large area display panels can be manufactured by making a mask according to input data and by using that mask in a microlithographic exposing device. The invention according to new (by the letter of 13-03-2001) independent claims 1, 13 and 21 is intended for improving the precision when manufacturing large area display panels. It might be argued that there are some similarities between manufacturing large area display panels and semiconductor manufacturing. However, although documents D1-D2 disclose solutions for problems related to semiconductor wafer production, which may appear similar to the solution defined in new (by the letter of 13-03-2001) independent claims 1, 13 and 21, these solutions are not applicable for solving position errors occurring in large area display panel manufacturing. Neither of documents D1-D2 teaches or suggests that large area display panels could be made by using the principles of those documents. It can not be considered obvious, for a person skilled in the art, to both realise that the general principle of D1-D2 could be applied on large area display panels and then also provide a special solution for problems that are only occurring in large area displays. Consequently, the invention according to new (by the letter of 13-03-2001) independent claims 1, 13 and 21 is considered to involve an inventive step.

The invention according to new (by the letter of 13-03-2001) claims 1-22 is novel, is considered to involve an inventive step and has industrial applicability.

CLAIMS

1. A method for producing large area display panels comprising the steps of:

producing a mask with a predetermined pattern according to input data (S1);

exposing a substrate with a radiant energy and with use of the mask to impose the pattern of the mask on the substrate, whereby said substrate has a layer being sensitive to said radiant energy (S2);

measuring the pattern on the substrate and detecting deviations relative to the intended pattern as given by the input data (S3);

producing a second mask with a pattern according to second input data and modified to diminish the measured deviations, and thus compensate for production distortions (S5);

using said modified mask in a subsequent fabrication of large area display panels (S6).

2. A method according to claim 1, whereby the radiant energy is light, used for microlithographically exposing a photosensitive substrate.

3. A method according to claim 1 or 2, whereby the measuring is made after processing steps, such as development, etching, blasting or high-temperature processing, following the exposure.

4. A method according to one of the claims 1-3, whereby the first and the second mask are based on the same input data.

5. A method according to one of the claims 1-3, whereby the first mask is a reference mask based on reference input data, whereas the second mask is based on the actual product data.

6. A method according to any one of the claims above, whereby the compensation used is a statistical

mean value of the compensation according to the measurement and compensations according to prior measurements.

7. A method according to any one of the claims above, wherein at least one additional measurement is made during the process, whereby the compensations is a statistical mean value of compensation parts related to the process before the first measurement, and the process between the measurements.

8. A method according to any one of the claims above, whereby the thickness of the sensitive layer before the exposure on the mask blank or on the substrate is measured, whereby said measurement data are used for additional compensation.

9. A method according to any one of the claims above, whereby already existing patterns on the substrate is measured prior to the exposure, whereby said measurement is used for additional compensation.

10. A method according to any one of the claims above, whereby said method is performed once for each substrate batch used in said fabrication.

11. A method according to any one of the claims above, whereby the measurement comprises measurement of position errors and pattern line width errors.

12. A method according to any one of the claims above, whereby said compensation is performed by time offsets or room offsets in the pattern writer used for producing the second mask.

13. A system for producing large area display panels comprising:

a first mask generator (1) for producing a mask with a predetermined pattern according to input data;

an exposing means (2) for exposing a substrate with radiant energy and with use of a mask to impose the pattern of the mask on the substrate, whereby said

substrate has a layer being sensitive to said radiant energy;

a measuring device (3) for measuring the pattern on the substrate and detecting deviations relative to the intended pattern as given by the input data;

a second mask generator (1) for producing a second mask according to second input data, and being controllable according to said measurement, to modify the pattern on the mask to compensate for the measured deviations, and thus compensate for production distortions.

14. A system according to claim 13, whereby the radiant energy is light, for microlithographically exposing a photosensitive substrate.

15. A system according to claim 13 or 14, comprising at least one additional measuring device, whereby the compensations is a statistical mean value of compensation parts related to the process before the first measurement, and the process between the measurements.

16. A system according to one of the claims 13-15, whereby the first and the second mask generator (1) are the same device.

17. A system according to any one of the claims 13-16, further comprising a second measuring device (4) for measuring the thickness of the light sensitive layer on the substrate prior to the exposure, whereby said measurement is used for additional compensation.

18. A system according to any one of the claims 13-17, further comprising a third measuring device (4) for measuring of existing patterns on the substrate prior to the exposure, whereby said measurement is used for additional compensation.

19. A system according to any one of the claims 13-18, whereby the first measuring device comprises means

for measurement of position errors and pattern line width errors.

20. A system according to any one of the claims 13-19, whereby said mask generator comprises a pattern writer, being controllable for said compensations by means of time offsets during the writing.

21. A large-area pattern generator comprising:

an exposing system for exposing a substrate with radiant energy and according to input pattern data to impose a predetermined pattern on the substrate, whereby said substrate has a layer being sensitive to said radiant energy;

a geometry-correcting system for correcting the pattern being imposed in the substrate according to digital distortion data, comprising effectuators for controlling at least one of the feeding of input pattern data in the data path, the movement of the substrate or the pattern placement on the substrate.

22. A pattern generator according to claim 21, wherein the distortion data is generated by measuring a pattern of a previous exposure and detecting deviations relative to the intended pattern as given by the input data.

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PATENT COOPERATION TREATY

PCT

REC'D 11 MAY 2001
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
PC-2006274		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE00/00097	18.01.2000	18.01.1999
International Patent Classification (IPC) or national classification and IPC7		
H 01 J 9/20 // G 03 F 7/20		
Applicant		
Micronic Laser Systems AB et al		

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Date of submission of the demand	Date of completion of this report
14.07.2000	03.05.2001
Name and mailing address of the IPEA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88 Telex 17978 PATOREG-S	Tomas Erlandsson/MN Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/00097

I. Basis of the report

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pages 1-9 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☒ the claims:
pages _____ , as originally filed
pages _____ , as amended (together with any statement) under article 19
pages _____ , filed with the demand
pages 10-13 , filed with the letter of 13.03.2001

☒ the drawings:
pages 1-2 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☐ the sequence listing part of the description:
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/00097

V. Reas ned statement under Article 35(2) with regard t novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-22	YES
	Claims		NO
Inventive step (IS)	Claims	1-22	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-22	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to a method and a system for producing large area display panels.

The object of the invention is t improve the precision of such systems. This is achieved by a process comprising the following steps:

- A first mask is manufactured on the basis of input data.
- A wafer is exposed, which results in a pattern based on the first mask.
- That pattern is compared with a desired pattern. In particular, position errors are measured.
- A second corrected mask is manufactured.
- The second mask is used in the manufacturing.

Documents cited in the International Search Report:

D1 US 5815685 A
D2 WO 9705526 A1

D1 relates to a system and method for correcting pattern data of an integrated circuit or the like. In one embodiment (column 13, lines 5-34) a reference pattern is used for exposing a resist layer on a substrate. A pattern is formed in the resist and then the substrate is etched. The pattern obtained after exposure and etching is measured and compared with the reference pattern. Finally some kind of correction processing is made. The method mainly concerns correction of light proximity effects.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

In D2 a lithography system with a programmable reticle, is disclosed. The system is intended for manufacturing integrated circuits. It is shown that it is well known to expose a wafer by using a first mask, to compare the obtained result with a desired one and to make a new mask based on that comparison (side 2, lines 3-16, side 7, lines 19-28, figure 1). The object of this system is to correct logical errors in the input data by re-programming the programmable reticle.

As mentioned in the present patent application, large area display panels can be manufactured by making a mask according to input data and by using that mask in a microlithographic exposing device. The invention according to new (by the letter of 13-03-2001) independent claims 1, 13 and 21 is intended for improving the precision when manufacturing large area display panels. It might be argued that there are some similarities between manufacturing large area display panels and semiconductor manufacturing. However, although documents D1-D2 disclose solutions for problems related to semiconductor wafer production, which may appear similar to the solution defined in new (by the letter of 13-03-2001) independent claims 1, 13 and 21, these solutions are not applicable for solving position errors occurring in large area display panel manufacturing. Neither of documents D1-D2 teaches or suggests that large area display panels could be made by using the principles of those documents. It can not be considered obvious, for a person skilled in the art, to both realise that the general principle of D1-D2 could be applied on large area display panels and then also provide a special solution for problems that are only occurring in large area displays. Consequently, the invention according to new (by the letter of 13-03-2001) independent claims 1, 13 and 21 is considered to involve an inventive step.

The invention according to new (by the letter of 13-03-2001) claims 1-22 is novel, is considered to involve an inventive step and has industrial applicability.

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WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :
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(11) International Publication Number: WO 00/42630

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(22) International Filing Date: 18 January 2000 (18.01.00)

(30) Priority Data:
9900114-1 18 January 1999 (18.01.99) SE

(71) Applicant *(for all designated States except US)*: MICRONIC LASER SYSTEMS AB [SE/SE]; Box 3141, S-183 03 Täby (SE).

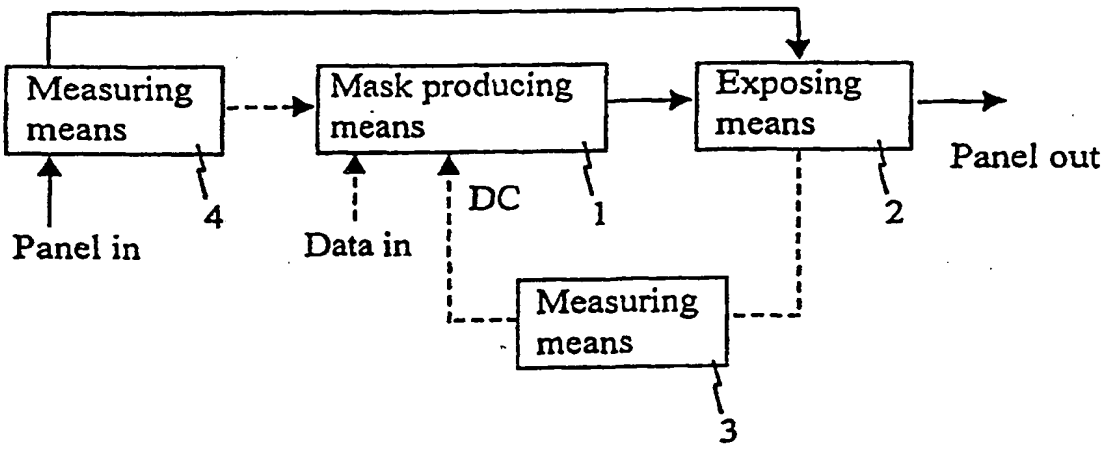
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: EKBERG, Peter [SE/SE]; Norsbacken 5, S-181 31 Lidingö (SE).

(74) Agent: AWAPATENT AB; Box 11394, S-404 28 Göteborg (SE).

(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), DM, EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (Utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SYSTEM FOR PRODUCTION OF LARGE AREA DISPLAY PANELS WITH IMPROVED PRECISION



(57) Abstract

The present invention relates to a method and a system for producing large area display panels with improved precision. The system according to the invention comprises a first mask producing means (1) for producing a mask with a predetermined pattern according to input data and microlithographic exposing means (2) for exposing a photosensitive substrate with light and with use of a mask to impose the pattern of the mask on the substrate, whereby said substrate has a layer being sensitive to said light. Further, the system comprises measuring means (3) for measuring the pattern on the substrate and detecting deviations relative to the intended pattern as given by the input data, and second mask producing means (1) for producing a second mask according to second input data, and being controllable according to said measurement, to modify the pattern on the mask to compensate for the measured deviations, and thus compensate for production distortions.

09/869119
JC03 Rec'd PCT/PTO 25 JUN 2001

SYSTEM FOR PRODUCTION OF LARGE AREA DISPLAY PANELS WITH IMPROVED PRECISION

Field of the invention

The present invention relates to a method and a system for producing large area display panels with improved precision.

Background of the invention

It is known beforehand in the art to produce large area display panels. This is typically accomplished by first producing a mask according to input data, and subsequently to use said mask in a microlithographic exposing device to produce panels with said pattern. The precision for the panels are of utmost importance, and much effort is taken to improve the precision in the pattern production as well as in the exposure of the panels. E.g. the laser writers often used for mask production comprises compensation means to compensate for scale errors, orthogonality errors, stage bows, local offset errors etc.

However, there are still significant precision errors, because of different conditions and surroundings for the different production devices, systematic errors, errors caused by the processing of the plate, such as the development, etching, blasting and high temperature processing steps. Further, large area display panels are extremely sensitive for errors, while even very small deviations from the intended pattern may be visible. These errors make the production costly and tedious, and give rise to a large number of rejected defect panels.

Summary of the invention

It is therefore an object of the present invention to provide a method and a system for producing large area display panels with improved precision.

This object is achieved with a method and a system according to the appended claims.

Brief description of the drawings

For exemplifying purposes, the invention will be described in closer detail in the following with reference to embodiments thereof illustrated in the attached drawings, *wherein:*

Fig 1 is a mask producing apparatus according to the prior art;

Fig 2 is a schematic view of a system according to one embodiment of the invention; and

Fig 3 is a schematic flow chart of a method according to one embodiment of the invention.

Description of preferred embodiments

Referring to fig 2, a first embodiment of the system for producing large area display panels according to the invention. The system could be used for producing shadow masks for conventional CRT (Cathode Ray Tube) displays, but is especially useful for producing TFT (Thin Film Transistor), CF (Color Filter), PDP (Plasma Display Panel) or PALC (Plasma-addressed liquid crystal) displays.

The system comprises a first mask producing means 1 for producing a mask with a predetermined pattern according to input data. The mask producing means is preferably a microlithographic writing device for writing with high precision on photosensitive substrates. The term writing should be understood in a broad sense, meaning exposure of photoresist and photographic emulsion, but also the action of light on other light

sensitive media such as dry-process paper, by ablation or chemical processes activated by light or heat. Light is not limited to mean visible light, but a wide range of wavelengths from infrared to extreme UV. Such a mask producing apparatus is previously known from e.g. EP 0 467 076 by the same applicant. In general the apparatus comprises, as is shown in fig 1, a light source 51, such as a laser, a first lens 52 to contract the light beams, a modulator 53 to produce the desired pattern to be written, the modulator being controlled according to input data, a reflecting mirror 54 to direct the beams towards the substrate 56, and a lens 55 to contract the beams before it reaches the substrate. The mirror 54 is used for the scanning operation to sweep the beam along scan lines on the substrate. Instead of a mirror, other scanning means may be used, such as a rotating polygon, rotating prism, rotating hologram, an acousto-optic deflector, an electro-optic deflector, a galvanometer or any similar device. It is also possible to use raster scanning or spatial light modulators. Further, the substrate is preferably arranged on an object table which has a motion in two orthogonal directions relative to the optical writing system, by means of two electrical servo motors.

The system according to the invention further comprises microlithographic exposing means 2 for exposing a photosensitive panel substrate with light and with use of the mask to impose the pattern of the mask on the substrate, whereby said substrate has a layer being sensitive to said light. Several such exposing means are also previously known in the art. The exposing means could be of the contact copy type, proximity exposure type, or a projection aligner. The system according to the invention could also be used in a direct writer, whereby the compensation is not made in a physical mask,

but in a data mapping controlling the writing beam. For TFT and CF display panels projection aligners are usually used, and for PDP and PALC the contact or proximity type are frequently used.

Furthermore, the system comprises measuring means 3 for measuring the pattern on the substrate and detecting deviations relative to the intended pattern as given by the input data. This could be done by measuring the geometrical position of the pattern, preferably at some reference positions, to get a so called registration mapping, and compare it with the intended pattern which is deducible from the input data. Further, the width of lines in the pattern, the so called CD (Critical dimension), could be measured. Measuring equipment is commercially available, and for example the equipment could comprise a CCD-camera or be based on interferometry.

From the measuring means 3 a distortion control signal is sent to a second mask producing means 4. This second mask producing means could be a separate apparatus, but is preferably the same as the first mask producing means 1. This second mask producing means is fed with input data describing the intended mask pattern to be written, and is also fed with the distortion control signal from the measuring means 3, whereby the writing process for producing the second mask is controlled to modify the pattern to compensate for the measured deviations, and thus compensate for production distortions. The measurement is preferably made after the subsequent processing steps of the panel as well, i.e. the development, blasting and/or etching, whereby systematic errors from theses processes are taken care of in the compensation as well.

The compensation in the mask writer could be accomplished in different ways. In a writer of the type

described above, with an object table continuously moving in a slow strip direction and a scanner sweeping in a fast scanning direction, the compensation could be made according to a surface mapping. According to this mapping the compensation in the scanning direction could be accomplished by e.g. offsetting the starting time of the beam during the scanning. In the stripe direction the compensation could also be made by time offsets, either directly or indirectly by means of different ramp functions. There are also other possible way to accomplish such compensation. For example the compensation could be made by controlling the servo motors for the object table, by adjustment of the time dependent angle of the scanners, by changing the input data or by controlling an internal control unit such as piezoelectrically controlled mirrors.

However, if a direct writer is used, the same type of compensation could be made in real time.

Compensation for deviations in the line width, CD, could be accomplished in the same way as deviations in the registration. However, this compensation could also be made by changes in the power of the writing beam, i.e. the exposing dose, by changing the laser output or having an analog modulator. This compensation could be accomplished by means of a herefore adapted dose mapping to control the dose.

When the second mask is used in the same exposing means 2 all systematic errors depending on different temperature conditions, errors in the exposing means etc., are compensated for, and the pattern precision of the produced display panels are greatly improved.

The first mask could either contain the same pattern as the intended pattern for the second mask, i.e. the pattern not being compensated, or contain a reference pattern, intended for deviation measure only.

Further, error data could be accumulated, and a rolling means value could be used for the compensation. The error compensation could also be a combination of several different part error compensations. Those part compensations could be based on the premises for the process, e.g. which stepper and type of glass that is being used. Hereby the total error compensation could be a combination of one or several error compensations for each process step.

Above, a system for passive distortion control has been described. In this system compensation is made for the processes and equipment being used in the system. However, the compensation is not adapted for different panel substrates. In this passive system a measurement to alter the distortion compensation is preferably made once for every new batch of substrates, and thereafter the same mask is used for producing all the panels in the batch. This passive distortion control is specifically useful for production of TFT or CF displays. The requested precision for the patterns on the mask for this production is extremely high, and the masks are very difficult, and thereby expensive, to manufacture. On the other hand the masks last for a long time in this production.

The system according to the invention could also comprise second measuring means 4 for measuring the thickness of the light sensitive layer on the substrate prior to the exposure, whereby said measurement is also used for said compensation. Hereby the compensation is adapted for varying resist layers between different batches of substrates. Such batch wise compensation could also be accomplished with use of data specified by the manufacturer.

This second measuring means 4 could also be used for measuring each and every panel substrate that is going to

be exposed, and thereafter adapt the process for each individual panel. Hereby the system could compensate for varying glass quality in different panels, varying thickness and quality of the resist or emulsion of the substrate area, different form variations etc. This active distortion control is especially useful for production of PDP or PALC display panels, where the masks are comparably easy and inexpensive to produce. This method could also be used for direct writers.

In the active distortion control the panel is initially measured, regarding e.g. resist thickness. Many such measuring methods are available for someone skilled in the art, e.g. a test exposure, dosimetry, of the substrate with different doses, by profilometry, interferometry, confocal microscopy, by an interferometric method or the like. The shape of the substrate could also be initially measured, and this could be accomplished by known methods such as moiré interferometry, projected fringes, laser triangulation, ordinary interferometry etc. Preferably already existing patterns are also initially measured, whereas such exists. Display panels are usually exposed in several separate steps, typically 3-7 exposing steps, and normally the same exposing station is used for all the exposures. By writing masks with compensation for individual errors in different station the display producer could schedule the production more freely, independent of which stations that is used.. This is of great importance for making the production more efficient and the utilization of the stations better.

Referring now to fig 2, a method for producing large area display panels according to the invention, and with use of the above-mentioned system will be described.

The method according to the invention comprises a first step S1 in which a mask with a predetermined

pattern according to input data is produced. Thereafter the mask is used for microlithographically exposing a photosensitive substrate with light to impose the pattern of the mask on the substrate, whereby said substrate has a layer being sensitive to said light, in step S2. The exposed pattern is then measured, possibly after several subsequent processing steps, or even in the finished product, in S3, to detect deviations of the exposed pattern relative to the intended pattern as given by the input data. In step S4 a distortion control mapping is then produced, to be used in step S5 during production of a second mask having a pattern according to input data and modified to diminish the measured deviations, and thus to compensate for production distortions. In the last step S6 the second modified mask is then used in a photolithographic fabrication of display panels. Similar compensation may be used in a direct writer, where the compensation could be made in a data mapping.

Further, the present invention relates to a large-area pattern generator, for producing e.g. masks for producing large-area display panels such as is described above. The large-area pattern generator according to the invention comprises an exposing system for exposing a substrate with radiant energy and according to input pattern data to impose a predetermined pattern on the substrate, whereby said substrate has a layer being sensitive to said radiant energy, as is previously described. It further comprises a geometry-correcting system for correcting the pattern being imposed in the substrate according to digital distortion data, comprising effectuators for controlling at least one of the feeding of input pattern data in the data path, the movement of the substrate or the pattern placement on the substrate, as is likewise described in the foregoing.

The invention has above been described with reference to a microlithography system, where photons (light) is used as the radiant energy. However, other types of radiant energy may be used as well, such as charged particles, electrons, ions, EUV (Extreme Ultra Violet), and other radiant energies suitable for substrate exposure. Further, other types of pattern generator may be used. For example, the pattern generator may use an acousto-optic modulator to control the radiant energy according to input data, as well as a voltage controlled modulator or an SLM (Spatial Light Modulator). If an SLM is used, the pattern generator may either be of the type using raster scanning or the type using shaped beams.

The invention makes the production of large area display panels more efficient and cost effective, at the same time as the pattern precision is improved. However several variations of the above-mentioned embodiments are possible, and obvious for a person skilled in the art. Such obvious modifications must be considered as being part of the invention, as it is defined by the following claims.

CLAIMS

1. A method for producing large area display panels comprising the steps of:

producing a mask with a predetermined pattern according to input data (S1);

exposing a substrate with a radiant energy and with use of the mask to impose the pattern of the mask on the substrate, whereby said substrate has a layer being sensitive to said radiant energy (S2);

measuring the pattern on the substrate and detecting deviations relative to the intended pattern as given by the input data (S3);

producing a second mask with a pattern according to second input data and modified to diminish the measured deviations, and thus compensate for production distortions (S5);

using said modified mask in a subsequent fabrication of large area display panels (S6).

2. A method according to claim 1, whereby the radiant energy is light, used for microlithographically exposing a photosensitive substrate.

3. A method according to claim 1 or 2, whereby the measuring is made after processing steps, such as development, etching, blasting or high-temperature processing, following the exposure.

4. A method according to one of the claims 1-3, whereby the first and the second mask are based on the same input data.

5. A method according to one of the claims 1-3, whereby the first mask is a reference mask based on reference input data, whereas the second mask is based on the actual product data.

6. A method according to any one of the claims above, whereby the compensation used is a statistical

mean value of the compensation according to the measurement and compensations according to prior measurements.

7. A method according to any one of the claims above, wherein at least one additional measurement is made during the process, whereby the compensations is a statistical mean value of compensation parts related to the process before the first measurement, and the process between the measurements.

8. A method according to any one of the claims above, whereby the thickness of the sensitive layer before the exposure on the mask blank or on the substrate is measured, whereby said measurement data are used for additional compensation.

9. A method according to any one of the claims above, whereby already existing patterns on the substrate is measured prior to the exposure, whereby said measurement is used for additional compensation.

10. A method according to any one of the claims above, whereby said method is performed once for each substrate batch used in said fabrication.

11. A method according to any one of the claims above, whereby the measurement comprises measurement of position errors and pattern line width errors.

12. A method according to any one of the claims above, whereby said compensation is performed by time offsets or room offsets in the pattern writer used for producing the second mask.

13. A system for producing large area display panels comprising:

a first mask generator (1) for producing a mask with a predetermined pattern according to input data;

an exposing means (2) for exposing a substrate with radiant energy and with use of a mask to impose the pattern of the mask on the substrate, whereby said

substrate has a layer being sensitive to said radiant energy;

a measuring device (3) for measuring the pattern on the substrate and detecting deviations relative to the intended pattern as given by the input data;

a second mask generator (1) for producing a second mask according to second input data, and being controllable according to said measurement, to modify the pattern on the mask to compensate for the measured deviations, and thus compensate for production distortions.

14. A system according to claim 13, whereby the radiant energy is light, for microlithographically exposing a photosensitive substrate.

15. A system according to claim 13 or 14, comprising at least one additional measuring device, whereby the compensations is a statistical mean value of compensation parts related to the process before the first measurement, and the process between the measurements.

16. A system according to one of the claims 13-15, whereby the first and the second mask generator (1) are the same device.

17. A system according to any one of the claims 13-16, further comprising a second measuring device (4) for measuring the thickness of the light sensitive layer on the substrate prior to the exposure, whereby said measurement is used for additional compensation.

18. A system according to any one of the claims 13-17, further comprising a third measuring device (4) for measuring of existing patterns on the substrate prior to the exposure, whereby said measurement is used for additional compensation.

19. A system according to any one of the claims 13-18, whereby the first measuring device comprises means

for measurement of position errors and pattern line width errors.

20. A system according to any one of the claims 13-19, whereby said mask generator comprises a pattern writer, being controllable for said compensations by means of time offsets during the writing.

21. A large-area pattern generator comprising:

an exposing system for exposing a substrate with radiant energy and according to input pattern data to impose a predetermined pattern on the substrate, whereby said substrate has a layer being sensitive to said radiant energy;

a geometry-correcting system for correcting the pattern being imposed in the substrate according to digital distortion data, comprising effectuators for controlling at least one of the feeding of input pattern data in the data path, the movement of the substrate or the pattern placement on the substrate.

22. A pattern generator according to claim 21, wherein the distortion data is generated by measuring a pattern of a previous exposure and detecting deviations relative to the intended pattern as given by the input data.

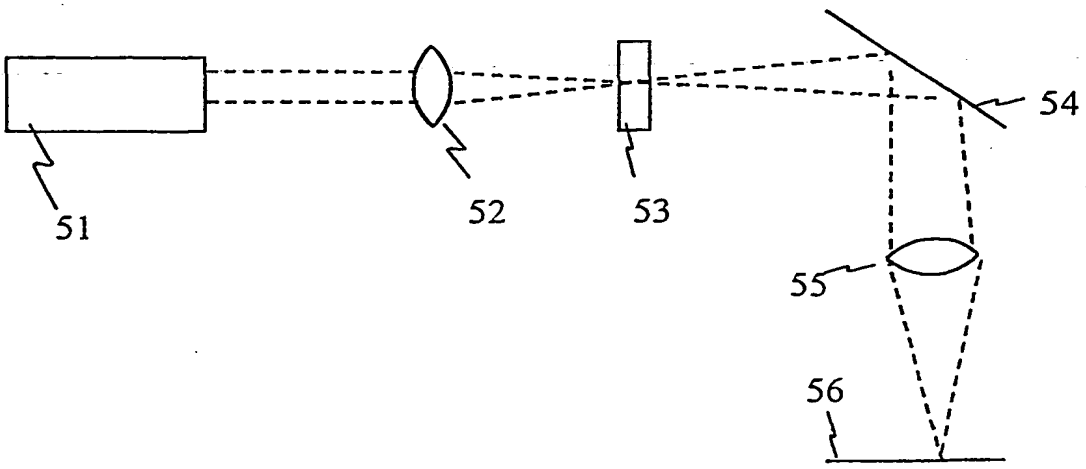


Fig 1 - Prior art

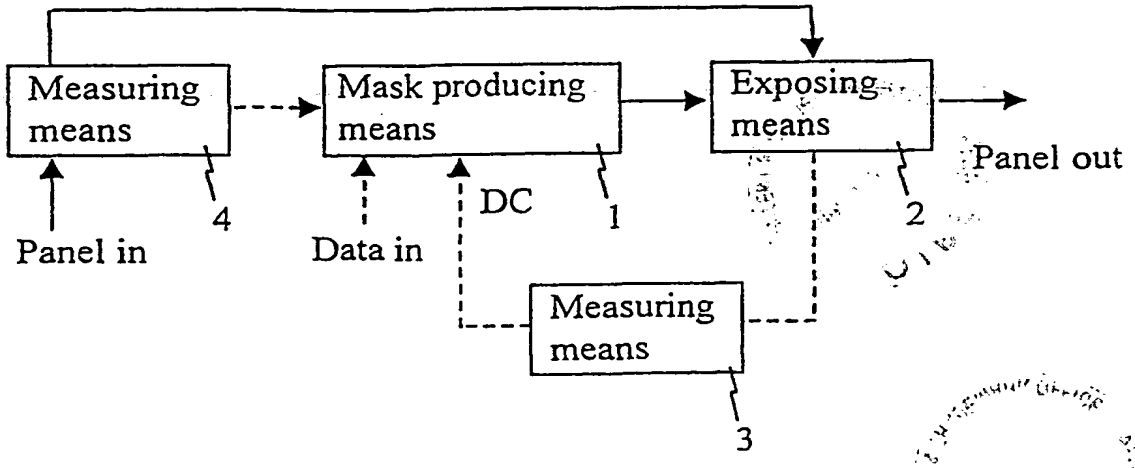

Measuring means
Mask producing means
Exposing means
Panel out
Panel in
4
Data in
DC
1
2
Measuring means
3

Fig 2

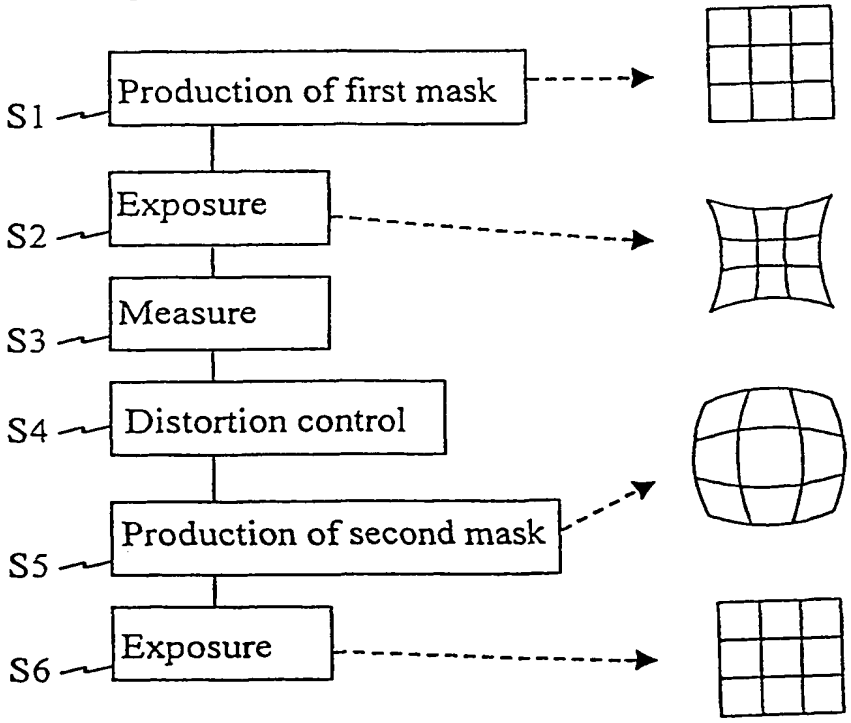

S1
Production of first mask
S2
Exposure
S3
Measure
S4
Distortion control
S5
Production of second mask
S6
Exposure

Fig 3